1   **<u>CLAIMS</u>**

2   What is claimed is:

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1   1.   A jitter buffer system for reducing jitter in a packet audio reception device, the

2   jitter buffer system comprising:

3   a jitter buffer for storing plurality of audio frames and providing each of the

4   plurality of audio frames to a decompression circuit upon receipt of a signal therefore;

5   a delay calculation module for receiving each of the plurality of audio frames, and

6   for each of the plurality of audio frames:

7   calculating a delay value, the delay value being equal to a time difference

8   between an output time stamp value and a transmission time stamp assigned to the

9   frame by a transmitting system; and

10   writing the frame to the jitter buffer;

11   a output time stamp index for determining an initial value of the output time

12   stamp value following receipt of a jitter buffer latency value and incrementing the output

13   time stamp value upon each release of a frame from the jitter buffer to the

14   decompression circuit, the initial value being equal to the sum of the transmission time

15   stamp assigned to the first frame and the jitter buffer latency value, each incremental

16   output time stamp being an incremental time period added to the output time stamp

17   value;

18   a histogram module coupled to each of the output time stamp index and the

19   delay calculation module, the histogram module for periodically calculating a target

20   delay value which, based on a buffered history of values representing the delay value of

21   each of a fixed quantity of the most recently received frames from the sequence of

22   receive frames, would have resulted in a predetermined portion of the fixed quantity of

23   frames being dropped, adjusting the jitter buffer latency value to a value equal to the

24   target value, and providing the jitter buffer latency value to the output time stamp index.

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1   2.   The jitter buffer system of claim 1, wherein the delay calculation module further

2   provides for:

3   dropping the frame if the delay value is less than zero;

4   dropping the frame if the delay value is greater than a predetermined maximum

5 delay value; and

6   writing the frame to the jitter buffer only if the delay value is greater than zero and

7 less than a predetermined maximum.

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1 3.   The jitter buffer system of claim 2, wherein the histogram module only adjusts the

2 jitter buffer latency value to the target value if the difference between the jitter buffer

3 latency value and the target value is greater than a preconfigured hysteresis threshold.

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1 4.   The jitter buffer system of claim 2, wherein the histogram module further:

2   adjusts the jitter buffer latency value to a maximum preconfigured jitter buffer

3 latency value if the target delay value is greater than the maximum preconfigured jitter

4 buffer latency value; and

5   adjusts the jitter buffer latency value to a minimum preconfigured jitter buffer

6 latency value if the target delay value is less than the minimum preconfigured jitter

7 buffer latency value.

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1 5.   The jitter buffer system of claim 2, wherein the histogram module further

2   decrements the jitter buffer latency value by a predetermined maximum

3 decrement value if adjusting the jitter buffer latency value to the target delay would

4 result in decrementing the jitter buffer latency value by more than the predetermined

5 maximum decrement value; and

6   increments decrements the jitter buffer latency value by a predetermined

7 maximum increment value if adjusting the jitter buffer latency value to the target delay

8 would result in incrementing the jitter buffer latency value by more than the

9 predetermined maximum increment value.

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1 6.   The jitter buffer system of claim 2, wherein the histogram module:

2   calculates a histogram value from each delay value, the histogram value being

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3   the delay value less the then current jitter buffer latency value;

4   stores each histogram value in a sub gram associated with the then current jitter

5   buffer latency value, the sub gram storing a predetermined quantity of histogram values

6   and being complete when the predetermined quantity of histogram values have been

7   stored in the sub-gram; and

8   calculating a target delay value upon completion of the sub-gram; the target

9   delay value being a value which would have resulted in a predetermined portion of the

10 frames associated with the histogram values stored in a predetermined quantity of the

11 most recently completed sub-grams being dropped.

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1   7.   The jitter buffer system of claim 6, wherein the histogram module calculates the

2   target delay value by:

3   determining a determining a low value which the predetermine portion of the

4   histogram values are les than the low value and the remainder of the histogram values

5   are greater than the low value; and

6   setting the target delay value to the difference between zero and the low value.

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1   8.   The jitter buffer system of claim 6, wherein the histogram module only adjusts the

2   jitter buffer latency value to the target value if the difference between the jitter buffer

3   latency value and the target value is greater than a preconfigured hysteresis threshold.

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1   9.   The jitter buffer system of claim 6, wherein the histogram module further:

2   adjusts the jitter buffer latency value to a maximum preconfigured jitter buffer

3   latency value if the target delay value is greater than the maximum preconfigured jitter

4   buffer latency value; and

5   adjusts the jitter buffer latency value to a minimum preconfigured jitter buffer

6   latency value if the target delay value is less than the minimum preconfigured jitter

7   buffer latency value.

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1   10.   The jitter buffer system of claim 6, wherein the histogram module further

2   decrements the jitter buffer latency value by a predetermined maximum

3   decrement value if adjusting the jitter buffer latency value to the target delay would

4   result in decrementing the jitter buffer latency value by more than the predetermined

5   maximum decrement value; and

6   increments decrements the jitter buffer latency value by a predetermined

7   maximum increment value if adjusting the jitter buffer latency value to the target delay

8   would result in incrementing the jitter buffer latency value by more than the

9   predetermined maximum increment value.

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1   11.   A method of reducing jitter in a packet audio reception device, the method

2   comprising:

3   receiving each of a plurality of audio frames;

4   for each of the plurality of audio frames:

5   calculating a delay, the delay value being equal to a time difference

6   between an output time stamp value and a transmission time stamp assigned to the

7   frame by a transmitting system;

8   dropping the frame if the delay value is less than zero;

9   dropping the frame if the delay value is greater than a predetermined

10   maximum delay value; and

11   storing the frame in a jitter buffer only if the delay value is greater than

12   zero and less than the predetermined maximum delay value;

13   providing each of the plurality of audio frames stored in the jitter buffer to a

14   decompression circuit upon receipt of a signal therefore;

15   determining an initial output time stamp value upon each adjustment of a jitter

16   buffer latency value, the initial output time stamp value being equal to the sum of the

17   transmission time stamp and the jitter buffer latency value;

18   incrementing the output time stamp value upon each release of a frame from the

19   jitter buffer;

20   periodically calculating a target delay value which, based on a buffered history of

21   values representing the delay value of each of a fixed quantity of the most recently

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22   received frames from the sequence of receive frames, would have resulted in a

23   predetermined portion of the fixed quantity of frames being dropped; and

24   adjusting the jitter buffer latency value to a value equal to the target delay value.

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1   12.   The method of claim 11, wherein the step of adjusting the jitter buffer latency

2   value to the target value is only performed if the difference between the jitter buffer

3   latency value and the target value is greater than a preconfigured hysteresis threshold.

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1   13.   The method of claim 11, further comprising:

2   adjusting the jitter buffer latency value to a maximum preconfigured jitter buffer

3   latency value if the target delay value is greater than the maximum preconfigured jitter

4   buffer latency value; and

5   adjusting the jitter buffer latency value to a minimum preconfigured jitter buffer

6   latency value if the target delay value is less than the minimum preconfigured jitter

7   buffer latency value.

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1   14.   The method of claim 11, further comprising:

2   decrementing the jitter buffer latency value by a predetermined maximum

3   decrement value if adjusting the jitter buffer latency value to the target delay would

4   result in decrementing the jitter buffer latency value by more than the predetermined

5   maximum decrement value; and

6   incrementing decrements the jitter buffer latency value by a predetermined

7   maximum increment value if adjusting the jitter buffer latency value to the target delay

8   would result in incrementing the jitter buffer latency value by more than the

9   predetermined maximum increment value.

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1   15.   The method of claim 11, further comprising:

2   calculating a histogram value from each delay value, the histogram value being

3   the delay value less the then current jitter buffer latency value;

4   storing each histogram value in a sub gram associated with the then current jitter

5   buffer latency value, the sub gram storing a predetermined quantity of histogram values

6   and being complete when the predetermined quantity of histogram values have been

7   stored in the sub-gram; and

8   calculating the target delay value upon completion of the sub-gram; the target

9   delay value being the value which would have resulted in a predetermined portion of the

10   frames associated with the histogram values stored in a predetermined quantity of the

11   most recently completed sub-grams being dropped.

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1   15.   The method of claim 15, wherein the step of calculating the target delay value

2   comprises:

3   determining a determining a low value which the predetermine portion of the

4   histogram values are les than the low value and the remainder of the histogram values

5   are greater than the low value; and

6   setting the target delay value to the difference between zero and the low value.

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1   17.   The method of claim 15, wherein the step of adjusting the jitter buffer latency

2   value to the target value is only performed if the difference between the jitter buffer

3   latency value and the target value is greater than a preconfigured hysteresis threshold.

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1   18.   The method of claim 15, further comprising:

2   adjusts the jitter buffer latency value to a maximum preconfigured jitter buffer

3   latency value if the target delay value is greater than the maximum preconfigured jitter

4   buffer latency value; and

5   adjusts the jitter buffer latency value to a minimum preconfigured jitter buffer

6   latency value if the target delay value is less than the minimum preconfigured jitter

7   buffer latency value.

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1   19.   The method of claim 15, further comprising:

2   decrements the jitter buffer latency value by a predetermined maximum

3   decrement value if adjusting the jitter buffer latency value to the target delay would

4   result in decrementing the jitter buffer latency value by more than the predetermined

5   maximum decrement value; and

6   increments decrements the jitter buffer latency value by a predetermined

7   maximum increment value if adjusting the jitter buffer latency value to the target delay

8   would result in incrementing the jitter buffer latency value by more than the

9   predetermined maximum increment value.

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